74VCX162245

Low-Voltage 1.8/2.5/3.3V 16-Bit Transceiver

With 26 Ω Series Resisters on A Outputs and 3.6 V–Tolerant Inputs and Outputs (3–State, Non–Inverting)

ON Semiconductor

http://onsemi.com

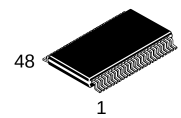
The 74VCX162245 is an advanced performance, non–inverting 16–bit transceiver. It is designed for very high–speed, very low–power operation in 1.8 V, 2.5 V or 3.3 V systems.

When operating at 2.5 V (or 1.8 V) the part is designed to tolerate voltages it may encounter on either inputs or outputs when interfacing to 3.3 V busses. It is guaranteed to be over–voltage tolerant to 3.6 V.

The VCX162245 is designed with byte control. It can be operated as two separate octals, or with the controls tied together, as a 16–bit wide function. It is designed with 26 Ω series resistors in each of the A outputs to reduce noise. The Transmit/Receive (T/$\overline{R}$n) inputs determine the direction of data flow through the bi–directional transceiver. Transmit (active–HIGH) enables data from A ports to B ports; Receive (active–LOW) enables data from B to A ports. The Output Enable inputs ($\overline{OE}$n), when HIGH, disable both A and B ports by placing them in a HIGH Z condition.

- Designed for Low Voltage Operation: V_{CC} = 1.65–3.6 V
- 3.6 V Tolerant Inputs and Outputs
- High Speed Operation: 3.4 ns max for 3.0 to 3.6 V
  4.3 ns max for 2.3 to 2.7 V
  8.6 ns max for 1.65 to 1.95 V
- Static Drive: ±24 mA Drive at 3.0 V
  ±18 mA Drive at 2.3 V
  ±3 mA Drive at 1.65 V
- Supports Live Insertion and Withdrawal
- I_{OFF} Specification Guarantees High Impedance When V_{CC} = 0 V
- Near Zero Static Supply Current in All Three Logic States (20 μA) Substantially Reduces System Power Requirements
- Latchup Performance Exceeds ±300 mA @ 125°C
- ESD Performance: Human Body Model >2000 V; Machine Model >200 V

MARKING DIAGRAM



TSSOP–48
DT SUFFIX
CASE 1201

A = Assembly Location
WL = Wafer Lot
YY = Year
WW = Work Week

ORDERING INFORMATION

Device	Package	Shipping
74VCX162245DT	TSSOP	39 / Rail
74VCX162245DTR	TSSOP	2500 / Reel

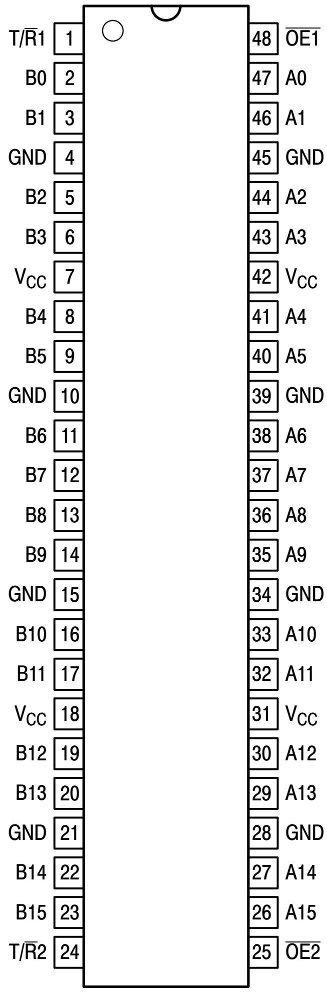


Figure 1. 48–Lead Pinout
(Top View)

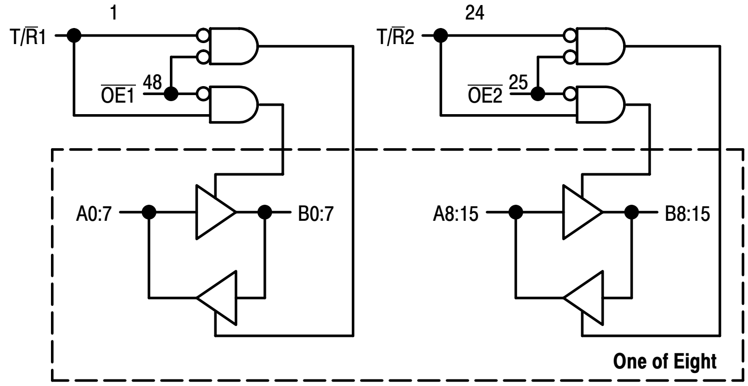
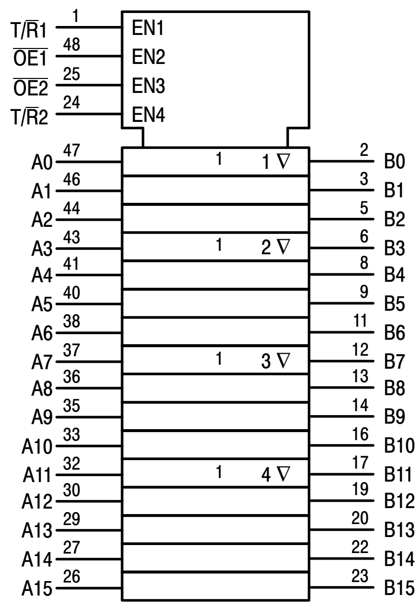


Figure 2. Logic Diagram



PIN NAMES

Pins	Function
$\overline{OEn}$	Output Enable Inputs
T/R̄n	Transmit/Receive Inputs
A0–A15	Side A Inputs or 3–State Outputs
B0–B15	Side B Inputs or 3–State Outputs

Inputs		Outputs	Inputs		Outputs
$\overline{OE1}$	T/R̄1		$\overline{OE2}$	T/R̄2	
L	L	Bus B0:7 Data to Bus A0:7	L	L	Bus B8:15 Data to Bus A8:15
L	H	Bus A0:7 Data to Bus B0:7	L	H	Bus A8:15 Data to Bus B8:15
H	X	High Z State on A0:7, B0:7	H	X	High Z State on A8:15, B8:15

H = High Voltage Level; L = Low Voltage Level; X = High or Low Voltage Level and Transitions Are Acceptable

ABSOLUTE MAXIMUM RATINGS*

Symbol	Parameter	Value	Condition	Unit
V_{CC}	DC Supply Voltage	–0.5 to +4.6		V
V_I	DC Input Voltage	$-0.5 \leq V_I \leq +4.6$		V
V_O	DC Output Voltage	$-0.5 \leq V_O \leq +4.6$	Output in 3–State	V
		$-0.5 \leq V_O \leq V_{CC} + 0.5$	Note 1.; Outputs Active	V
I_{IK}	DC Input Diode Current	–50	V_I < GND	mA
I_{OK}	DC Output Diode Current	–50	V_O < GND	mA
		+50	V_O > V_{CC}	mA
I_O	DC Output Source/Sink Current	±50		mA
I_{CC}	DC Supply Current Per Supply Pin	±100		mA
I_{GND}	DC Ground Current Per Ground Pin	±100		mA
T_{STG}	Storage Temperature Range	–65 to +150		°C

* Absolute maximum continuous ratings are those values beyond which damage to the device may occur. Exposure to these conditions or conditions beyond those indicated may adversely affect device reliability. Functional operation under absolute–maximum–rated conditions is not implied.

1. I_O absolute maximum rating must be observed.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Typ	Max	Unit
V_{CC}	Supply Voltage — Operating Data Retention Only	1.65 1.2	3.3 3.3	3.6 3.6	V
V_I	Input Voltage	–0.3		3.6	V
V_O	Output Voltage — (Active State) (3–State)	0 0		V_{CC} 3.6	V
A Outputs					
I_{OH}	HIGH Level Output Current, V_{CC} = 3.0V – 3.6V			–12	mA
I_{OL}	LOW Level Output Current, V_{CC} = 3.0V – 3.6V			12	mA
I_{OH}	HIGH Level Output Current, V_{CC} = 2.3V – 2.7V			–8	mA
I_{OL}	LOW Level Output Current, V_{CC} = 2.3V – 2.7V			8	mA
I_{OH}	HIGH Level Output Current, V_{CC} = 1.65 – 1.95V			–3	mA
I_{OL}	LOW Level Output Current, V_{CC} = 1.65 – 1.95V			3	mA
B Outputs					
I_{OH}	HIGH Level Output Current, V_{CC} = 3.0V – 3.6V			–24	mA
I_{OL}	LOW Level Output Current, V_{CC} = 3.0V – 3.6V			24	mA
I_{OH}	HIGH Level Output Current, V_{CC} = 2.3V – 2.7V			–18	mA
I_{OL}	LOW Level Output Current, V_{CC} = 2.3V – 2.7V			18	mA
I_{OH}	HIGH Level Output Current, V_{CC} = 1.65 – 1.95V			–6	mA
I_{OL}	LOW Level Output Current, V_{CC} = 1.65 – 1.95V			6	mA
T_A	Operating Free–Air Temperature	–40		+85	°C
$\Delta t/\Delta V$	Input Transition Rise or Fall Rate, V_{IN} from 0.8V to 2.0V, V_{CC} = 3.0V	0		10	ns/V

DC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic	Condition	T_A = –40°C to +85°C Min	Max	Unit
V_{IH}	HIGH Level Input Voltage (Note 2.)	1.65V ≤ V_{CC} < 2.3V	0.65 x V_{CC}		V
		2.3V ≤ V_{CC} ≤ 2.7V	1.6		
		2.7V < V_{CC} ≤ 3.6V	2.0		
V_{IL}	LOW Level Input Voltage (Note 2.)	1.65V ≤ V_{CC} < 2.3V		0.35 x V_{CC}	V
		2.3V ≤ V_{CC} ≤ 2.7V		0.7	
		2.7V < V_{CC} ≤ 3.6V		0.8	
V_{OH}	HIGH Level Output Voltage A Outputs	1.65V ≤ V_{CC} ≤ 3.6V; I_{OH} = –100µA	V_{CC} – 0.2		V
		V_{CC} = 1.65V; I_{OH} = –3mA	1.4		
		V_{CC} = 2.3V; I_{OH} = –4mA	2.0		
		V_{CC} = 2.3V; I_{OH} = –6mA	1.8		
		V_{CC} = 2.3V; I_{OH} = –8mA	1.7		
		V_{CC} = 2.7V; I_{OH} = –6mA	2.2		
		V_{CC} = 3.0V; I_{OH} = –8mA	2.4		
		V_{CC} = 3.0V; I_{OH} = –12mA	2.2		
V_{OH}	HIGH Level Output Voltage B Outputs	1.65V ≤ V_{CC} ≤ 3.6V; I_{OH} = –100µA	V_{CC} – 0.2		V
		V_{CC} = 1.65V; I_{OH} = –6mA	1.25		
		V_{CC} = 2.3V; I_{OH} = –6mA	2.0		
		V_{CC} = 2.3V; I_{OH} = –12mA	1.8		
		V_{CC} = 2.3V; I_{OH} = –18mA	1.7		
		V_{CC} = 2.7V; I_{OH} = –12mA	2.2		
		V_{CC} = 3.0V; I_{OH} = –18mA	2.4		
		V_{CC} = 3.0V; I_{OH} = –24mA	2.2		
V_{OL}	LOW Level Output Voltage A Output	1.65V ≤ V_{CC} ≤ 3.6V; I_{OL} = 100µA		0.2	V
		V_{CC} = 1.65V; I_{OL} = 3mA		0.3	
		V_{CC} = 2.3V; I_{OL} = 6mA		0.4	
		V_{CC} = 2.3V; I_{OL} = 8mA		0.6	
		V_{CC} = 2.7V; I_{OL} = 6mA		0.4	
		V_{CC} = 3.0V; I_{OL} = 8mA		0.55	
		V_{CC} = 3.0V; I_{OL} = 12mA		0.8	
V_{OL}	LOW Level Output Voltage B Output	1.65V ≤ V_{CC} ≤ 3.6V; I_{OL} = 100µA		0.2	V
		V_{CC} = 1.65V; I_{OL} = 6mA		0.3	
		V_{CC} = 2.3V; I_{OL} = 12mA		0.4	
		V_{CC} = 2.3V; I_{OL} = 18mA		0.6	
		V_{CC} = 2.7V; I_{OL} = 12mA		0.4	
		V_{CC} = 3.0V; I_{OL} = 18mA		0.4	
		V_{CC} = 3.0V; I_{OL} = 24mA		0.55	
I_I	Input Leakage Current	1.65V ≤ V_{CC} ≤ 3.6V; 0V ≤ V_I ≤ 3.6V		±5.0	µA
I_{OZ}	3–State Output Current	1.65V ≤ V_{CC} ≤ 3.6V; 0V ≤ V_O ≤ 3.6V; V_I = V_{IH} or V_{IL}		±10	µA
I_{OFF}	Power–Off Leakage Current	V_{CC} = 0V; V_I or V_O = 3.6V		10	µA
I_{CC}	Quiescent Supply Current (Note 3.)	1.65V ≤ V_{CC} ≤ 3.6V; V_I = GND or V_{CC}		20	µA
		1.65V ≤ V_{CC} ≤ 3.6V; 3.6V ≤ V_I, V_O ≤ 3.6V		±20	µA
ΔI_{CC}	Increase in I_{CC} per Input	2.7V < V_{CC} ≤ 3.6V; V_{IH} = V_{CC} – 0.6V		750	µA

2. These values of V_I are used to test DC electrical characteristics only.
3. Outputs disabled or 3–state only.

AC CHARACTERISTICS (Note 4.; $t_R = t_F = 2.0ns$; $C_L = 30pF$; $R_L = 500\Omega$)

Symbol	Parameter	Waveform	Limits						Unit
			$T_A = -40°C$ to $+85°C$						
			V_{CC} = 3.0V to 3.6V		V_{CC} = 2.3V to 2.7V		V_{CC} = 1.65 to1.95V		
			Min	Max	Min	Max	Min	Max	
t_{PLH} t_{PHL}	Propagation Delay Input to Output (A > B)	1	0.8 0.8	2.5 2.5	1.0 1.0	3.0 3.0	1.5 1.5	6.0 6.0	ns
t_{PLH} t_{PHL}	Propagation Delay Input to Output (B > A)	1	0.8 0.8	3.4 3.4	1.0 1.0	4.3 4.3	1.5 1.5	8.6 8.6	ns
t_{PZH} t_{PZL}	Output Enable Time to High and Low Level (A > B)	2	0.8 0.8	3.8 3.8	1.0 1.0	4.9 4.9	1.5 1.5	9.3 9.3	ns
t_{PZH} t_{PZL}	Output Enable Time to High and Low Level (B > A)	2	0.8 0.8	4.2 4.2	1.0 1.0	5.7 5.7	1.5 1.5	9.8 9.8	ns
t_{PHZ} t_{PLZ}	Output Disable Time From High and Low Level (A > B)	2	0.8 0.8	3.7 3.7	1.0 1.0	4.2 4.2	1.5 1.5	7.6 7.6	ns
t_{PHZ} t_{PLZ}	Output Disable Time From High and Low Level (B > A)	2	0.8 0.8	4.1 4.1	1.0 1.0	4.8 4.8	1.5 1.5	8.6 8.6	ns
t_{OSHL} t_{OSLH}	Output–to–Output Skew (Note 5.)			0.5 0.5		0.5 0.5		0.75 0.75	ns

4. For C_L = 50pF, add approximately 300ps to the AC maximum specification.
5. Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH–to–LOW (t_{OSHL}) or LOW–to–HIGH (t_{OSLH}); parameter guaranteed by design.

DYNAMIC SWITCHING CHARACTERISTICS

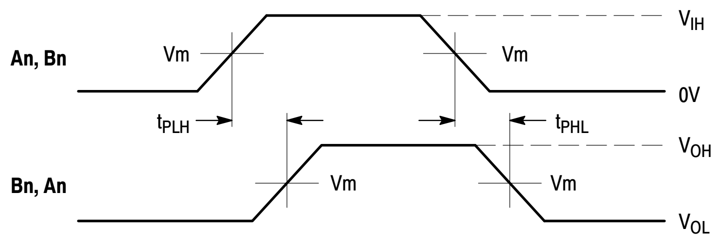
Symbol	Characteristic	Condition	$T_A = +25°C$ Typ	Unit
V_{OLP}	Dynamic LOW Peak Voltage (A > B) (Note 6.)	V_{CC} = 1.8V, C_L = 30pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	0.25	V
		V_{CC} = 2.5V, C_L = 30pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	0.6	
		V_{CC} = 3.3V, C_L = 30pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	0.8	
V_{OLP}	Dynamic LOW Peak Voltage (B > A) (Note 6.)	V_{CC} = 1.8V, C_L = 30pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	0.15	V
		V_{CC} = 2.5V, C_L = 30pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	0.25	
		V_{CC} = 3.3V, C_L = 30pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	0.35	
V_{OLV}	Dynamic LOW Valley Voltage (A > B) (Note 6.)	V_{CC} = 1.8V, C_L = 30pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	–0.25	V
		V_{CC} = 2.5V, C_L = 30pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	–0.6	
		V_{CC} = 3.3V, C_L = 30pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	–0.8	
V_{OLV}	Dynamic LOW Valley Voltage (B > A) (Note 6.)	V_{CC} = 1.8V, C_L = 30pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	–0.15	V
		V_{CC} = 2.5V, C_L = 30pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	–0.25	
		V_{CC} = 3.3V, C_L = 30pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	–0.35	
V_{OHV}	Dynamic HIGH Valley Voltage (A > B) (Note 7.)	V_{CC} = 1.8V, C_L = 30pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	1.5	V
		V_{CC} = 2.5V, C_L = 30pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	1.9	
		V_{CC} = 3.3V, C_L = 30pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	2.2	
V_{OHV}	Dynamic HIGH Valley Voltage (B > A) (Note 7.)	V_{CC} = 1.8V, C_L = 30pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	1.55	V
		V_{CC} = 2.5V, C_L = 30pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	2.05	
		V_{CC} = 3.3V, C_L = 30pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	2.65	

6. Number of outputs defined as "n". Measured with "n–1" outputs switching from HIGH–to–LOW or LOW–to–HIGH. The remaining output is measured in the LOW state.
7. Number of outputs defined as "n". Measured with "n–1" outputs switching from HIGH–to–LOW or LOW–to–HIGH. The remaining output is measured in the HIGH state.

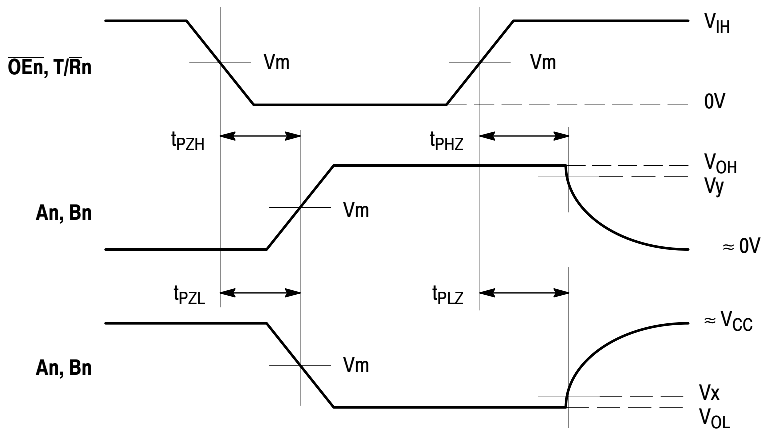
CAPACITIVE CHARACTERISTICS

Symbol	Parameter	Condition	Typical	Unit
C_{IN}	Input Capacitance	Note 8.	6	pF
C_{OUT}	Output Capacitance	Note 8.	7	pF
C_{PD}	Power Dissipation Capacitance	Note 8., 10MHz	20	pF

8. V_{CC} = 1.8, 2.5 or 3.3V; V_I = 0V or V_{CC}.



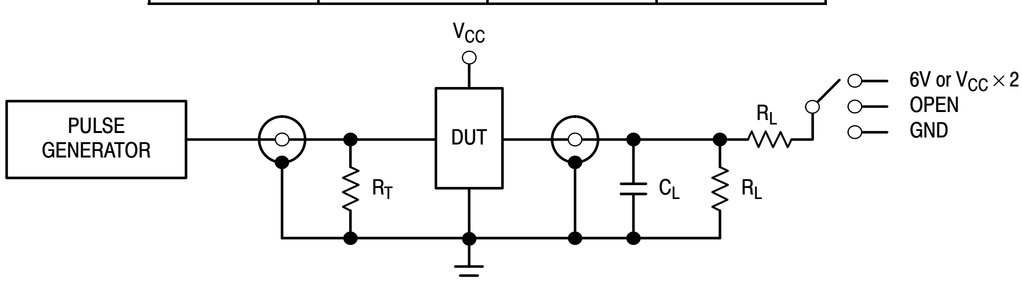
WAVEFORM 1 – PROPAGATION DELAYS
$t_R = t_F$ = 2.0ns, 10% to 90%; f = 1MHz; t_W = 500ns



WAVEFORM 2 – OUTPUT ENABLE AND DISABLE TIMES
$t_R = t_F$ = 2.0ns, 10% to 90%; f = 1MHz; t_W = 500ns

Figure 3. AC Waveforms

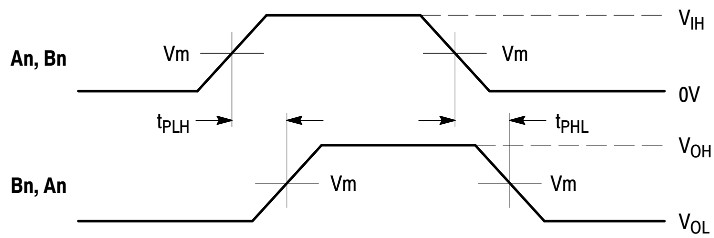
Symbol	V_{CC}		
	3.3V ±0.3V	**2.5V ±0.2V**	**1.8V ±0.15V**
V_{IH}	2.7V	V_{CC}	V_{CC}
V_m	1.5V	$V_{CC}/2$	$V_{CC}/2$
V_x	V_{OL} + 0.3V	V_{OL} + 0.15V	V_{OL} + 0.15V
V_y	V_{OH} – 0.3V	V_{OH} – 0.15V	V_{OH} – 0.15V



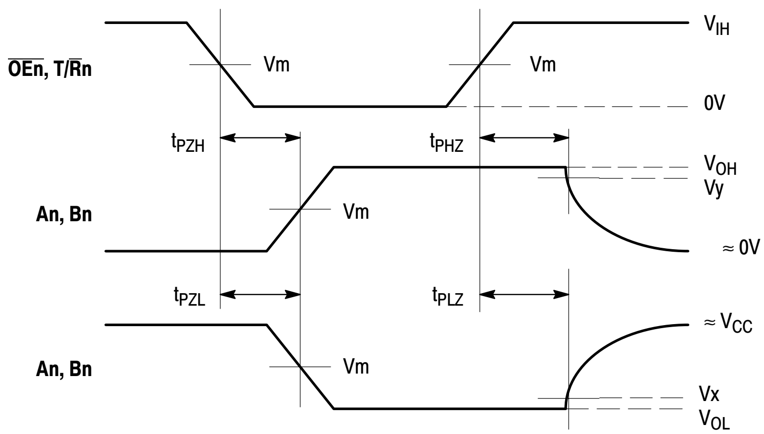
TEST	SWITCH
t_{PLH}, t_{PHL}	Open
t_{PZL}, t_{PLZ}	6V at V_{CC} = 3.3 ±0.3V; V_{CC}× 2 at V_{CC} = 2.5 ±0.2V; 1.8V ±0.15V
t_{PZH}, t_{PHZ}	GND

C_L = 30pF or equivalent (Includes jig and probe capacitance)
R_L = 500Ω or equivalent
R_T = Z_{OUT} of pulse generator (typically 50Ω)

Figure 4. Test Circuit



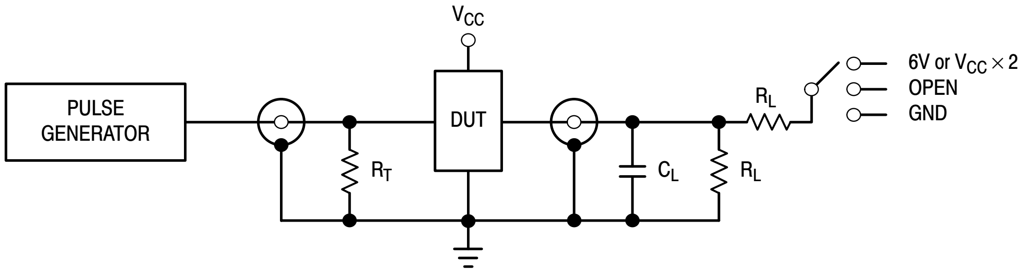
WAVEFORM 3 – PROPAGATION DELAYS
t_R = t_F = 2.0ns, 10% to 90%; f = 1MHz; t_W = 500ns



WAVEFORM 4 – OUTPUT ENABLE AND DISABLE TIMES
t_R = t_F = 2.0ns, 10% to 90%; f = 1MHz; t_W = 500ns

Figure 5. AC Waveforms

Symbol	V_{CC}	
	3.3V ±0.3V	**2.7V**
V_{IH}	2.7V	2.7V
V_m	1.5V	1.5V
V_x	V_{OL} + 0.3V	V_{OL} + 0.3V
V_y	V_{OH} – 0.3V	V_{OH} – 0.3V



TEST	SWITCH
t_{PLH}, t_{PHL}	Open
t_{PZL}, t_{PLZ}	6V at V_{CC} = 3.3 ±0.3V; $V_{CC} \times 2$ at V_{CC} = 2.5 ±0.2V; 1.8 ±0.15V
t_{PZH}, t_{PHZ}	GND

C_L = 50pF or equivalent (Includes jig and probe capacitance)
R_L = 500Ω or equivalent
R_T = Z_{OUT} of pulse generator (typically 50Ω)

Figure 6. Test Circuit

AC CHARACTERISTICS (t_R = t_F = 2.0ns; C_L = 50pF; R_L = 500Ω)

Symbol	Parameter	Waveform	Limits T_A = –40°C to +85°C V_{CC} = 3.0V to 3.6V Min	Max	V_{CC} = 2.7V Min	Max	Unit
t_{PLH} t_{PHL}	Propagation Delay Input to Output (A > B)	3	1.0 1.0	3.0 3.0		3.6 3.6	ns
t_{PLH} t_{PHL}	Propagation Delay Input to Output (B > A)	3	1.0 1.0	4.2 4.2		4.7 4.7	ns
t_{PZH} t_{PZL}	Output Enable Time to High and Low Level (A > B)	4	1.0 1.0	4.4 4.4		5.4 5.4	ns
t_{PZH} t_{PZL}	Output Enable Time to High and Low Level (B > A)	4	1.0 1.0	5.6 5.6		6.7 6.7	ns
t_{PHZ} t_{PLZ}	Output Disable Time From High and Low Level (A > B)	4	1.0 1.0	4.1 4.1		4.6 4.6	ns
t_{PHZ} t_{PLZ}	Output Disable Time From High and Low Level (B > A)	4	1.0 1.0	5.5 5.5		5.7 5.7	ns
t_{OSHL} t_{OSLH}	Output–to–Output Skew (Note 9.)			0.5 0.5		0.5 0.5	ns

9. Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH–to–LOW (t_{OSHL}) or LOW–to–HIGH (t_{OSLH}); parameter guaranteed by design.

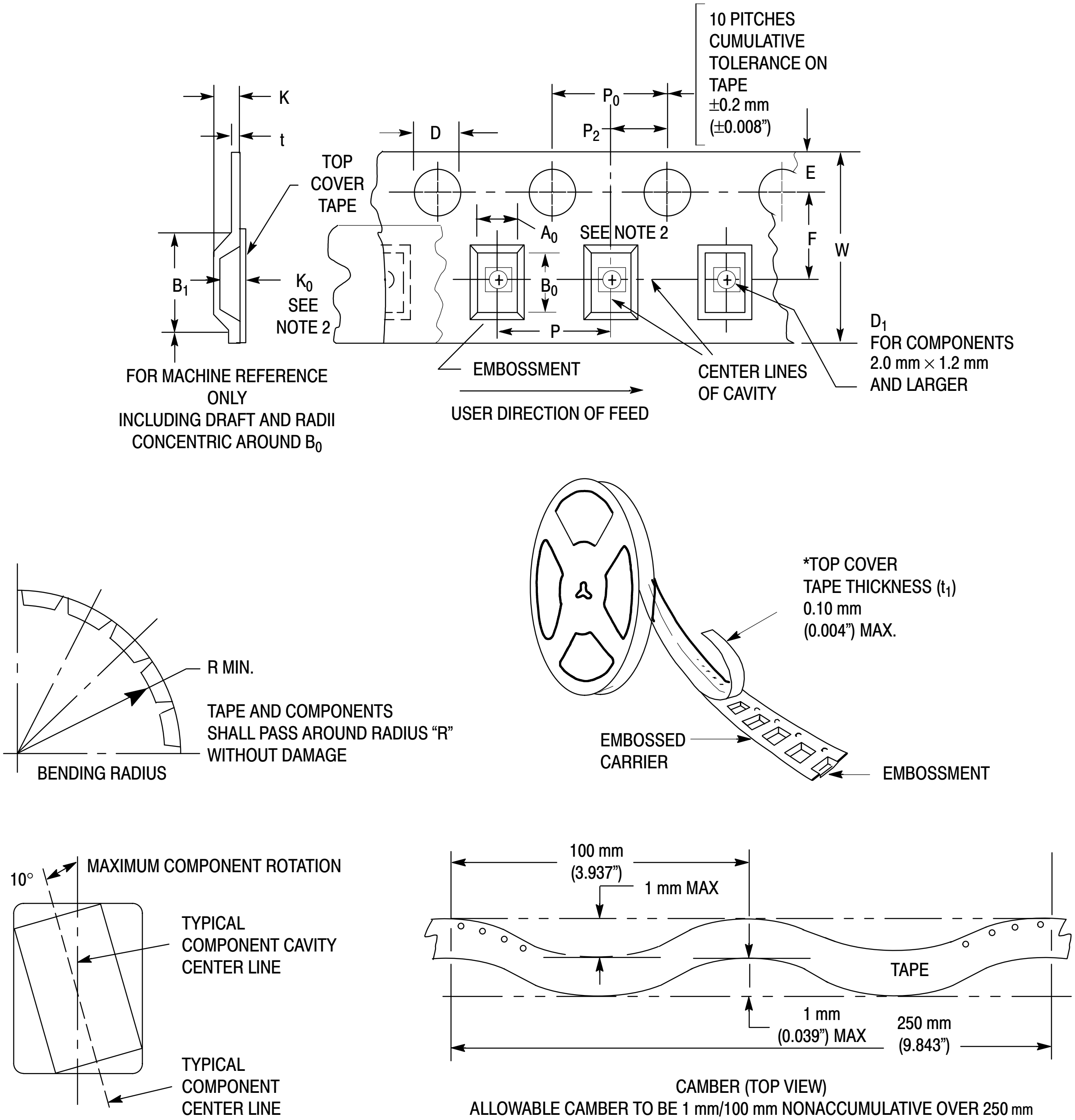


Figure 7. Carrier Tape Specifications

EMBOSSED CARRIER DIMENSIONS (See Notes 1 and 2)

Tape Size	B_1 Max	D	D_1	E	F	K	P	P_0	P_2	R	T	W
24mm	20.1mm (0.791")	1.5 + 0.1mm −0.0 (0.059 +0.004" −0.0)	1.5mm Min (0.060")	1.75 ±0.1 mm (0.069 ±0.004")	11.5 ±0.10 mm (0.453 ±0.004")	11.9 mm Max (0.468")	16.0 ±0.1 mm (0.63 ±0.004")	4.0 ±0.1 mm (0.157 ±0.004")	2.0 ±0.1 mm (0.079 ±0.004")	30 mm (1.18")	0.6 mm (0.024")	24.3 mm (0.957")

1. Metric Dimensions Govern–English are in parentheses for reference only.
2. A_0, B_0, and K_0 are determined by component size. The clearance between the components and the cavity must be within 0.05 mm min to 0.50 mm max. The component cannot rotate more than 10° within the determined cavity

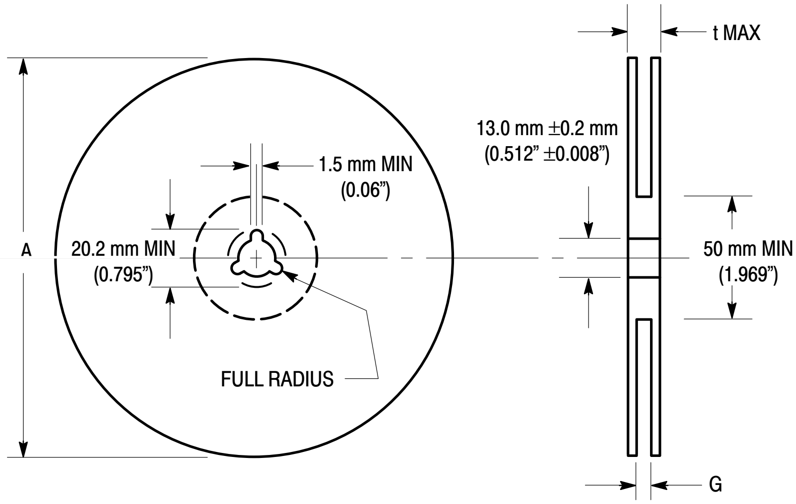


Figure 8. Reel Dimensions

REEL DIMENSIONS

Tape Size	A Max	G	t Max
24 mm	360 mm (14.173")	24.4 mm + 2.0 mm, −0.0 (0.961" + 0.078", −0.00)	30.4 mm (1.197")

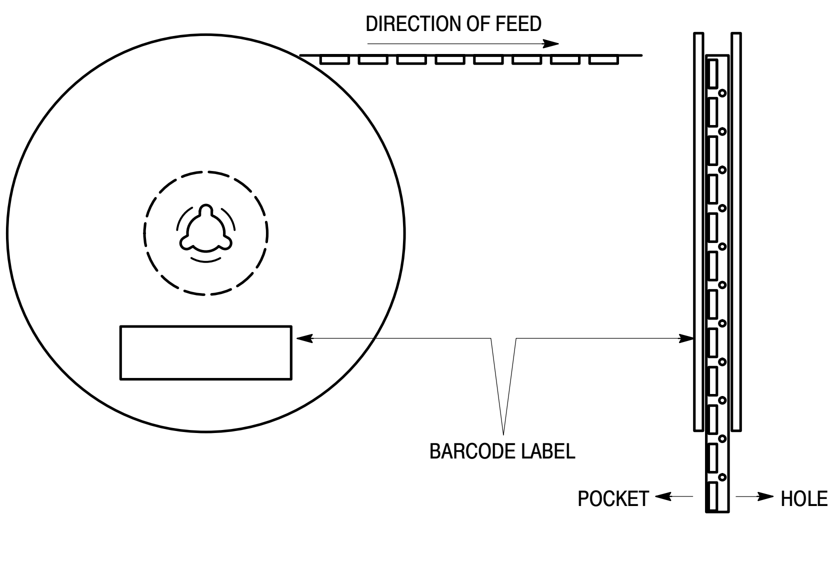


Figure 9. Reel Winding Direction

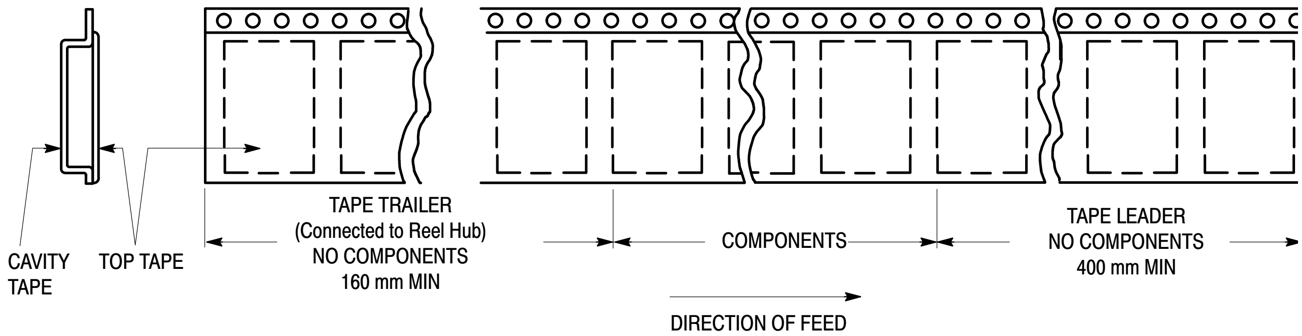


Figure 10. Tape Ends for Finished Goods

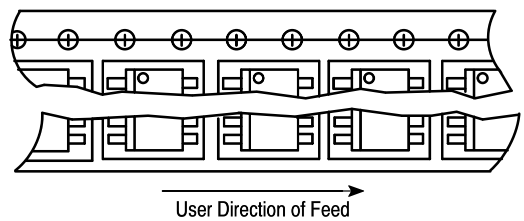
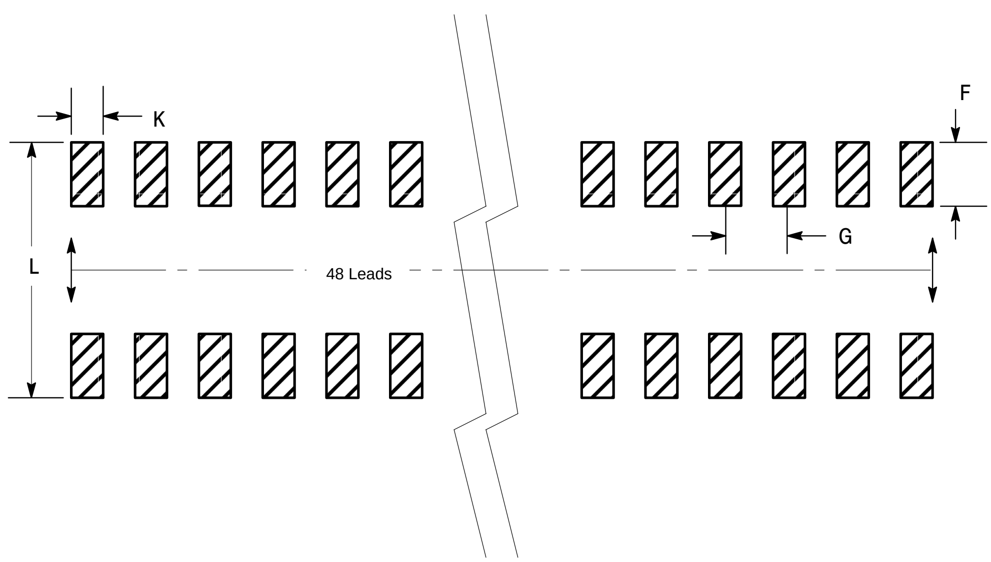


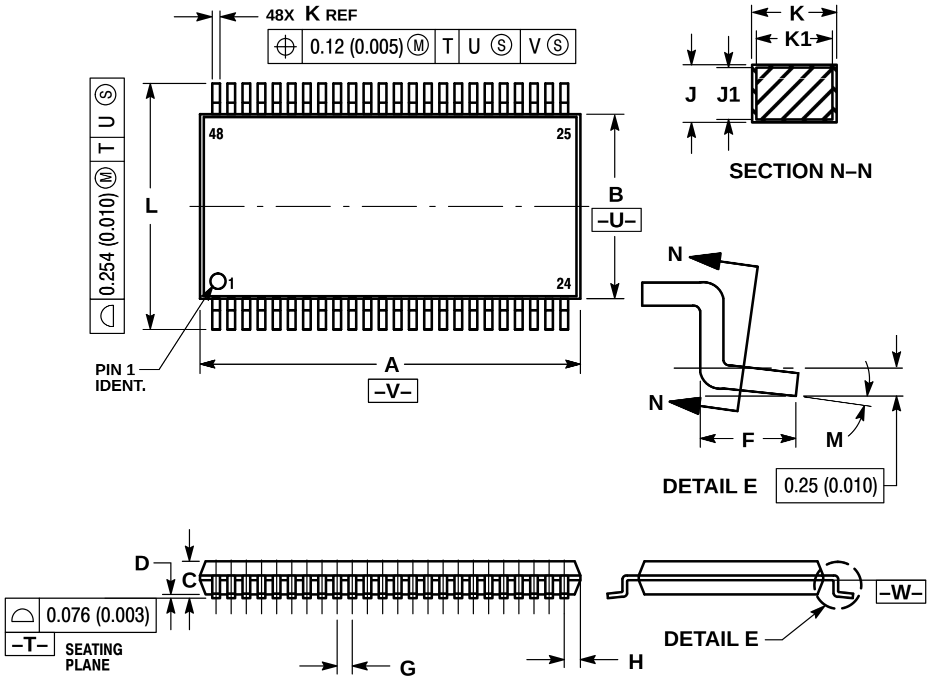
Figure 11. Reel Configuration



Package Footprint

PACKAGE DIMENSIONS

TSSOP
DT SUFFIX
CASE 1201–01
ISSUE A



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
5. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
6. DIMENSIONS A AND B ARE TO BE DETERMINED AT DATUM PLANE –W–.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	12.40	12.60	0.488	0.496
B	6.00	6.20	0.236	0.244
C	---	1.10	---	0.043
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.50 BSC		0.0197 BSC	
H	0.37	---	0.015	---
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.17	0.27	0.007	0.011
K1	0.17	0.23	0.007	0.009
L	7.95	8.25	0.313	0.325
M	0 °	8 °	0 °	8 °

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